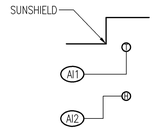


AI1	THERMOSTAT
AI2	HUMIDITY SENSOR

* LOCATE ON NORTHSIDE OF BUILDING.

GLOBAL PONTS
NO SCALE

SEQUENCE OF OPERATION

VAV SHUT-OFF TERMINAL UNITS

GENERAL: THIS SEQUENCE TYPICAL FOR ALL VAV BOXES. AN OVERRIDE SWITCH INTEGRAL TO EACH ZONE TEMPERATURE SENSOR SHALL RETURN THE RESPECTIVE RTU FROM UNOCCUPIED TO OCCUPIED BUT ONLY THE ZONE OVERRIDDEN SHALL RETURN TO OCCUPIED MODE TEMPERATURE SETTINGS. WHEN ANY OVERRIDE SWITCH IS ENERGIZED, RTU AND ALL VAV BOXES ASSOCIATED WITH THE ZONE OVERRIDDEN SHALL BE ENERGIZED THROUGH DDC CONTROL BUT ONLY THE ZONE OVERRIDDEN SHALL RETURN TO OCCUPIED MODE TEMPERATURE SETPOINTS. AFTER TWO HOURS (ADJUSTABLE), THE ZONE SHALL RETURN TO UNOCCUPIED MODE. ENERGIZED RTU AND ALL ASSOCIATED VAV BOXES SHALL BE RETURN TO UNOCCUPIED MODE UNLESS RTU IS UNDER CONTROL OF ANOTHER ZONE IN OVERRIDE POSITION.

COOLING-OCCUPIED: THE ZONE TEMPERATURE SENSOR THROUGH DDC CONTROL SHALL MODULATE THE PRIMARY AIR VALVE IN THE VAV BOX TO MAINTAIN ZONE TEMPERATURE SETPOINT OF 75°F (ADJUSTABLE), OPENING THE AIR VALVE ON A RISE IN SPACE TEMPERATURE, OR CLOSING IT ON A FALL IN SPACE TEMPERATURE, (NOT TO FALL BELOW MINIMUM SCHEDULED PRIMARY AIR QUANTITY).

HEATING-OCCUPIED: THE PRIMARY AIR VALVE SHALL START IN ITS MINIMUM SCHEDULED POSITION THRU DDC CONTROL. THE ZONE TEMPERATURE SENSOR THRU DDC CONTROL SHALL MODULATE HOT WATER CONTROL VALVE TO MAINTAIN ZONE TEMPERATURE SETPOINT (70°F ADJUSTABLE). IF SPACE TEMPERATURE IS SLOW TO RESPOND, CONTROLLER SHALL MODULATE PRIMARY AIR VALVE OPEN TO A MAXIMUM OF 80%. ON A FALL IN ZONE TEMPERATURE, THE OPPOSITE SHALL OCCUR.

COOLING-UNOCCUPIED: THE VAV BOX PRIMARY AIR VALVE SHALL BE FULLY CLOSED. ON A RISE IN ZONE TEMPERATURE ABOVE SETBACK SETPOINT (85°F ADJUSTABLE), THE VAV BOX PRIMARY AIR VALVE SHALL FULLY OPEN AND RESPECTIVE RTU SAF SHALL BE ENERGIZED AND OA DAMPER SHALL BE CLOSED. DDC CONTROLLER SHALL MODULATE RTU COOLING VALVE TO MAINTAIN 55°F SUPPLY AIR TEMPERATURE. RTU SHALL REMAIN ENERGIZED UNTIL ZONE SETBACK TEMPERATURE SETPOINT IS ACHIEVED. IF ZONE TEMPERATURE FALLS BELOW SETBACK SETPOINT, THE OPPOSITE SHALL OCCUR.

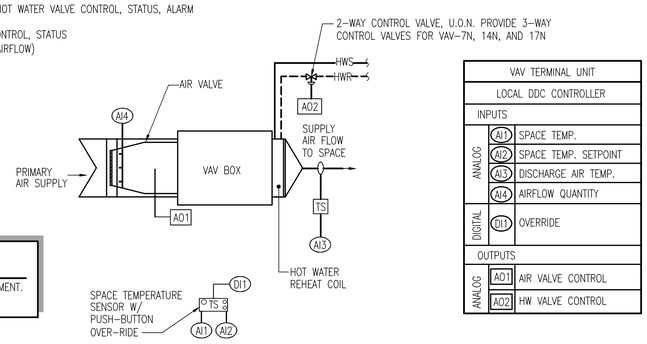
HEATING-UNOCCUPIED: THE VAV BOX PRIMARY AIR VALVE SHALL BE FULLY CLOSED. ON A FALL IN ZONE TEMPERATURE BELOW SETBACK SETPOINT (60°F ADJUSTABLE), THE RESPECTIVE ROOFTOP UNIT SAF SHALL BE ENERGIZED AND OA DAMPER SHALL BE CLOSED. DDC CONTROLLER SHALL CYCLE VAV BOX HW CONTROL VALVE TO MAINTAIN ZONE SETBACK TEMPERATURE SETPOINT. IF ZONE TEMPERATURE RISES ABOVE SETBACK SETPOINT, THE OPPOSITE SHALL OCCUR.

MORNING WARM-UP: PROVIDE OPTIMIZED START/STOP AT AN ADJUSTABLE SCHEDULED TIME PERIOD PRIOR TO OCCUPIED STATUS, THE UNIT SHALL GO INTO MORNING WARM-UP. THE VAV BOX AIR VALVE SHALL FULLY OPEN, VAV BOX HW VALVE SHALL BE FULLY OPEN TO THE COIL UNTIL OCCUPIED SPACE TEMPERATURE SETPOINT IS ACHIEVED. THE UNIT SHALL THEN MODULATE TO MAINTAIN SPACE OCCUPIED TEMPERATURE SETPOINT AS DESCRIBED ABOVE.

DDC/EMCS SIGNAL-FUNCTION:

ZONE TEMPERATURE SENSOR – AIR VALVE CONTROL, HOT WATER VALVE CONTROL, STATUS, ALARM
OVERRIDE SWITCH – OCCUPIED CONTROL, STATUS
HOT WATER CONTROL VALVE – ZONE TEMPERATURE CONTROL, STATUS
AIR VALVE – ZONE TEMPERATURE CONTROL, STATUS (AIRFLOW)

EXISTING EQUIPMENT NOTE:
INCORPORATE THIS SEQUENCE ON ALL EXISTING SIMILAR EQUIPMENT.

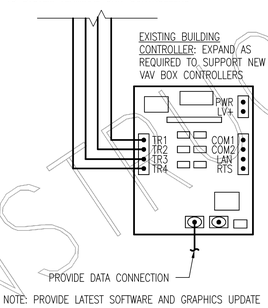


VAV TERMINAL UNIT		
LOCAL DDC CONTROLLER		
INPUTS		
ANALOG	AI1	SPACE TEMP.
	AI2	SPACE TEMP. SETPOINT
	AI3	DISCHARGE AIR TEMP.
	AI4	AIRFLOW QUANTITY
DIGITAL	DI1	OVERRIDE
OUTPUTS		
ANALOG	AO1	AIR VALVE CONTROL
	AO2	HW VALVE CONTROL

VAV SHUT-OFF TERMINAL UNIT CONTROL DIAGRAM
NO SCALE

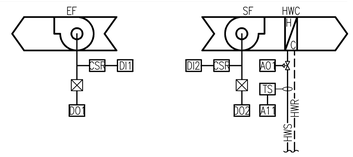
CONTROLS LEGEND

BAS	BUILDING AUTOMATION SYSTEM	AMS	AIR FLOW MEASURING STATION
CWR	CHILLED WATER RETURN	AI	ANALOG INPUT POINT
CWS	CHILLED WATER SUPPLY	AO	ANALOG OUTPUT POINT
DSS	DUCTLESS SPLIT SYSTEM DESIGNATION	DI	DIGITAL INPUT
EA	EXHAUST AIR	DM	DAMPER MOTOR ACTUATOR
EF	EXHAUST FAN	DO	DIGITAL OUTPUT
EF-1	EXHAUST FAN DESIGNATION	DPS	DIFFERENTIAL PRESSURE SENSOR
EUH-1	ELECTRIC UNIT HEATER DESIGNATION	FS	FREEZESTAT/FAN SWITCH
HWR	HOT WATER RETURN	LS	LIMIT SWITCH
HWS	HOT WATER SUPPLY	M	ACTUATOR
N.C.	NORMALLY CLOSED	SD	SMOKE DETECTOR
N.O.	NORMALLY OPEN	SPS	STATIC PRESSURE SWITCH
OA	OUTSIDE AIR	TS	TEMPERATURE SENSOR
RS/RL	REFRIGERANT SUCTION/LIQUID	VFD	VARIABLE FREQUENCY DRIVE
RTU-1	AIR HANDLING UNIT DESIGNATION	⊠	MOTOR STARTER
SA	SUPPLY AIR	T	THERMOSTAT
SF	SUPPLY AIR FAN	H	HUMIDITY SENSOR
TS	TEMPERATURE SENSOR		
TYP	TYPICAL		
UON	UNLESS OTHERWISE NOTED		
VAV	VARIABLE AIR VOLUME		

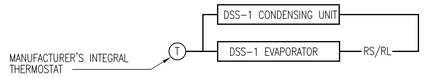


NOTE: PROVIDE LATEST SOFTWARE AND GRAPHICS UPDATE

DDC CONTROL SYSTEM GENERAL ARCHITECTURE
NO SCALE



EF-1 THRU EF-6, SF-1 THRU SF-6, AND HWC-1 THRU HWC-6

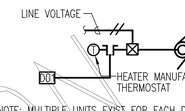


DSS-1 (NON-DDC)
NO SCALE

SEQUENCE OF OPERATION

DSS-1 (NON-DDC)

COOLING: UNIT SHALL BE CONTROLLED BY THE MANUFACTURERS INTEGRAL THERMOSTAT. WHEN THE SPACE TEMPERATURE RISES ABOVE THE COOLING SETPOINT (76°F), THE THERMOSTAT SHALL ENERGIZE THE DSS CONDENSER AND ENERGIZE THE INDOOR UNIT SUPPLY FAN. WHEN THE SPACE TEMPERATURE DROPS BELOW THE THERMOSTAT SETPOINT, THE OPPOSITE SHALL OCCUR.



ELECTRIC UNIT HEATER	
LOCAL DDC CONTROLER	
DO1	ON/OFF

NOTE: MULTIPLE UNITS EXIST, FOR EACH DESIGNATION.

EUH-1 THRU 10 (NON-DDC)
NO SCALE

SEQUENCE OF OPERATION

EUH-1 THRU 10 (NON-DDC)

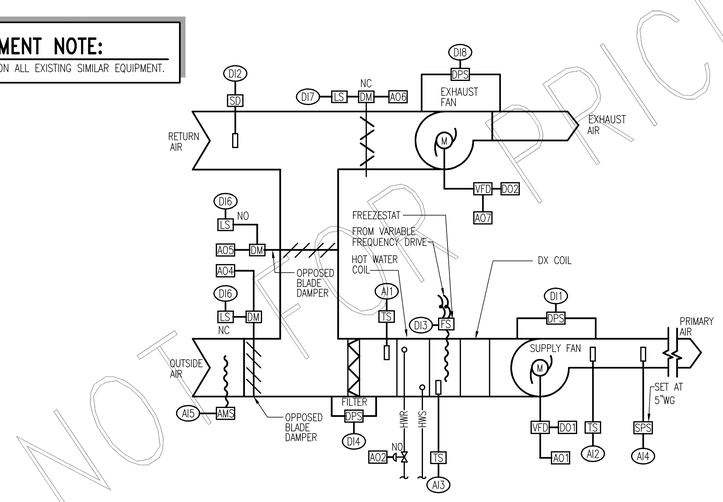
UNIT SHALL BE CONTROLLED BY A WALL MOUNTED THERMOSTAT. UPON A FALL IN SPACE TEMPERATURE BELOW 65°F, THE UNIT SHALL BE ENERGIZED. UPON A RISE IN SPACE TEMPERATURE ABOVE 70°F, THE OPPOSITE SHALL OCCUR. DDC SYSTEM SHALL ENERGIZE UNIT DURING OCCUPIED MODE ONLY.

EXHAUST/SUPPLY FAN		
LOCAL DDC CONTROLLER		
INPUTS		
ANALOG	AI1	HWS TEMP.
DIGITAL	DI1	EF STATUS
	DI2	SF STATUS
OUTPUTS		
ANALOG	AO1	HW VALVE CONTROL
DIGITAL	DO1	EF ON/OFF
	DO2	SF ON/OFF

SEQUENCE OF OPERATION

EXHAUST FAN SHALL BE CONTROLLED BY PUSH BUTTON ACTIVATION. WHEN THE PUSH BUTTON IS IN THE ON POSITION, THE ASSOCIATED EXHAUST FAN SHALL BE ENERGIZED. THE HW VALVE SHALL OPEN TO MAINTAIN 68°F LEAVING AIR TEMPERATURE AND THE SF SHALL BE ENERGIZED. WHEN OA TEMPERATURE IS LESS THAN 40°F, THE HWS VALVE SHALL OPEN AND PROVIDE 160°F EWT PRIOR TO SF START. WHEN THE PUSH BUTTON IS IN THE OFF POSITION, THE ASSOCIATED EXHAUST FAN AND SUPPLY FAN SHALL BE DE-ENERGIZED AND THE HW VALVE IS CLOSED.

EXISTING EQUIPMENT NOTE:
INCORPORATE THIS SEQUENCE ON ALL EXISTING SIMILAR EQUIPMENT.



INTERLOCKS: INTERLOCK AREA TIOLET EXHAUST FANS TO CYCLE WITH RTU OCCUPIED/UNOCCUPIED MODE.

RTU CONTROL DIAGRAM (DDC)
NO SCALE

AHU VAV		
LOCAL DDC CONTROLLER		
INPUTS		
ANALOG	AI1	MIXED AIR TEMPERATURE
	AI2	SUPPLY AIR TEMPERATURE
	AI3	HW COIL DISCHARGE AVERAGE
	AI4	UNIT DISCHARGE STATIC PRESSURE
	AI5	NOT USED
	AI6	OA AIRFLOW MEASURE STATION
DIGITAL	DI1	SUPPLY AIR FAN STATUS
	DI2	SMOKE DETECTOR
	DI3	FREEZESTAT
	DI4	FILTER STATUS
	DI5	OUTSIDE AIR DAMPER CLOSED
	DI6	RETURN AIR DAMPER CLOSED
	DI7	EXHAUST DAMPER CLOSED
	DI8	EF STATUS
OUTPUTS		
ANALOG	AO1	SF – VFD CONTROL
	AO2	HW VALVE CONTROL
	AO3	CW VALVE CONTROL
	AO4	OUTSIDE AIR DAMPER CONTROL
	AO5	RETURN AIR DAMPER CONTROL
	AO6	EXHAUST AIR DAMPER CONTROL
	AO7	EF – VFD CONTROL
DIGITAL	DO1	SUPPLY AIR FAN START
	DO2	EXHAUST AIR FAN START

SEQUENCE OF OPERATION

GENERAL: UNIT SHALL EMPLOY OPTIMUM START/STOP AND CRITICAL ZONE RESET.

COOLING-OCCUPIED/OVERRIDE: AHU SUPPLY FAN SHALL BE ENERGIZED AND RUN CONTINUOUSLY. OUTSIDE AND RETURN AIR DAMPERS SHALL MODULATE TO MAINTAIN MIN. O.A. FLOW AS MEASURED BY THE OUTSIDE AIR AIRFLOW MEASUREMENT STATION. THE O.A. DAMPER SHALL FULLY STROKE BEFORE THE R.A. DAMPER STARTS MODULATING. THE O.A. DAMPER LIMIT SWITCH SHALL SIGNAL THE DDC SYSTEM WHEN THE O.A. DAMPER IS FULLY CLOSED. DISCHARGE AIR TEMPERATURE CONTROLLER SHALL CYCLE COMPRESSORS MAINTAIN 55°F LEAVING AIR TEMPERATURE. HOT WATER CONTROL VALVE SHALL BE FULLY CLOSED TO COIL. PROVIDE OPTIMUM START/STOP.

COOLING-UNOCCUPIED: UNIT SHALL CYCLE AS IN OCCUPIED MODE UPON A CALL FOR COOLING FOR ANY ASSOCIATED VAV UNIT. THE OA AND EA DAMPER SHALL BE CLOSED.

HEATING-OCCUPIED: AHU SUPPLY AIR FAN SHALL BE ENERGIZED AND RUN CONTINUOUSLY. O.A. FLOW WILL BE MAINTAINED AS DESCRIBED IN COOLING-OCCUPIED MODE ABOVE. WHEN MIXED AIR TEMPERATURE DROPS TO 52°F, DISCHARGE AIR TEMPERATURE CONTROLLER THRU DDC CONTROL SHALL MODULATE THE 2-WAY HOT WATER VALVE TO MAINTAIN 55°F LEAVING AIR TEMPERATURE. THE CHILLED WATER VALVE SHALL BE FULLY CLOSED TO THE COIL.

HEATING-UNOCCUPIED: AHU SUPPLY SHALL CYCLE WITH A CALL FOR HEATING AND HOT WATER CONTROL VALVE SHALL BE CLOSED. OA AND EA DAMPERS SHALL BE CLOSED. HEATING NIGHT SETBACK CONTROL IS BY HW COILS IN VAV BOXES. SEE VAV BOX CONTROL.

TRANSITION FROM OCCUPIED TO UNOCCUPIED: AUTOMATICALLY THRU DDC CONTROL AND VIA OPTIMIZE START. SYSTEM SHALL ALSO BE ABLE TO BE RETURNED TO OCCUPIED MODE FROM UNOCCUPIED MODE BY THE OPERATOR WORKSTATION.

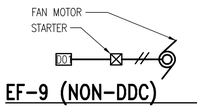
SAFETY CONTROL: SMOKE DETECTOR SHALL BE PROVIDED BY DIVISION 16. THROUGH DDC CONTROL IT SHALL DE-ENERGIZE THE ASSOCIATED RTU, ALL ASSOCIATED SUPPLY AND EXHAUST FANS (INCLUDING INTERLOCKS), SIGNAL FIRE ALARM PANEL AND CLOSE THE OUTSIDE AIR DAMPER UPON THE DETECTION OF THE PRODUCTS OF COMBUSTION.

FREEZE PROTECTION: IF MIXED AIR TEMPERATURE FALLS BELOW 40°F DURING HEATING MODE, THE FREEZE STAT SHALL CLOSE THE OUTSIDE AIR DAMPER, DE-ENERGIZE THE AHU SUPPLY AIR FAN AND FULLY OPEN THE HOT WATER VALVES TO COIL.

PRESSURE PROTECTION: A HIGH PRESSURE TRANSMITTER LOCATED AT THE SUPPLY FAN DISCHARGE SHALL DE-ENERGIZE THE SUPPLY AIR FAN IF ITS SETPOINT, 5" WG, IS REACHED.

ECONOMIZER: WHEN SPACE CALLS FOR A COOLING AND OA ENTHALPY CONDITIONS PERMIT, THE OUTSIDE AIR DAMPER SHALL MODULATE OPEN AND THE RETURN AIR DAMPER SHALL MODULATE CLOSED TO MAINTAIN SPACE TEMPERATURE SETPOINT.

MORNING WARM-UP: UNIT SHALL EMPLOY OPTIMUM START. DDC SYSTEM SHALL MONITOR RA TEMPERATURE. AHU SA FAN SHALL BE ENERGIZED TO 100% AND RUN UNTIL SETPOINT IS ACHIEVED.



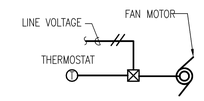
EF-9 (NON-DDC)

EXHAUST FAN	
LOCAL DDC CONTROLER	
DO1	ON/OFF

SEQUENCE OF OPERATION

EF-9 (DDC) AND ETR MAIN TOILET FAN

EXHAUST FAN SHALL RUN CONTINUOUSLY WHILE OCCUPIED.



EF-10 THRU 12 (NON-DDC)

SEQUENCE OF OPERATION

EF-10 THRU 12 (NON-DDC)

FAN SHALL BE CONTROLLED BY WALL MOUNTED THERMOSTAT. SET AT 80°F.

MORNING COOL-DOWN: THE UNIT SHALL EMPLOY OPTIMUM START PRIOR TO OCCUPIED STATUS, THE UNIT SHALL GO INTO MORNING COOL-DOWN. THE OA AND EA DAMPERS SHALL FULLY CLOSE, THE SUPPLY FAN SHALL MODULATE TO MAINTAIN DUCT STATIC PRESSURE, THE COMPRESSOR SHALL CYCLE TO MAINTAIN A 55°F LEAVING AIR TEMPERATURE AND THE HOT WATER VALVE SHALL BE FULLY CLOSED TO THE COIL. ASSOCIATED VAV BOX AIR VALVES SHALL INITIALLY BE FULLY OPEN AND THEN MODULATE TO MAINTAIN SPACE OCCUPIED TEMPERATURE SETPOINT, VAV BOX SUPPLY FANS SHALL BE ENERGIZED AND VAV BOX HW VALVES SHALL BE FULLY CLOSED TO THE COIL.

ALARMS: ALARM FOR DIRTY FILTER: WHEN PRESSURE DROP EXCEEDS 0.5" WG ABOVE INITIAL PRESSURE DROP. ALARM IF LEAVING AIR TEMPERATURE EXCEEDS 60°F IN COOLING MODE OR DROPS BELOW 50°F IN HEATING MODE. ALARM IF AHU SUPPLY OR EXHAUST AIR FAN FAILS TO START OR FAILS DURING OPERATION. ALARM IF UNIT DISCHARGE STATIC PRESSURE EXCEEDS 5" W.G.

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WARSAW CAMPUS
MECHANICAL CONTROLS

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